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# A COMPARATIVE STUDY OF SOCIO-ECONOMIC BENEFITS FROM MICROGRIDS, SHS AND THE GRID IN RURAL SOUTH ASIA

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# Research Objectives

What are the socio-economic impacts of small-scale electricity (SME) systems on rural communities in South Asia?

SME **vs** Unconnected **vs** Grid-connected

Focus:

Service conditions

Income and livelihood

Women/health

Children/education

Business decisions



# Site Selection

## Selection Criteria

- Technology
- SME Vintage

## All districts

Technology: SHS  
Vintage: 0-12 years

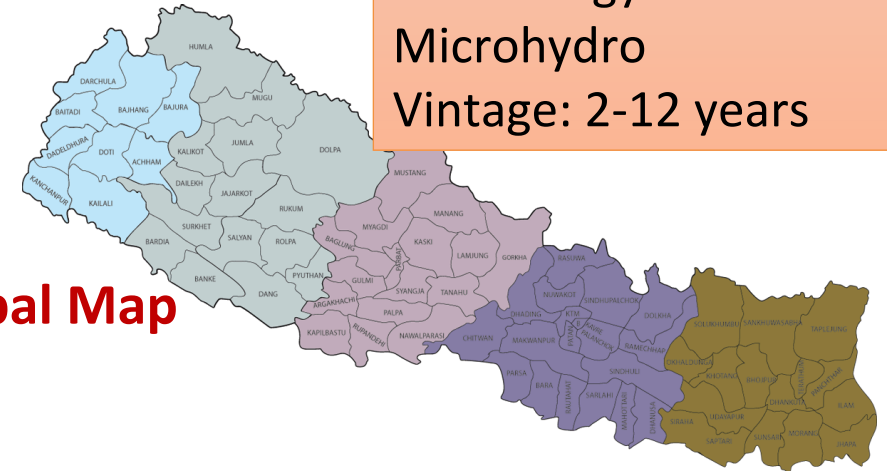
## Kavre/Sindhuli, Nepal

Technology:

Microhydro

Vintage: 2-12 years

Nepal Map



## West Champaran, West Bihar

Technology: Biomass (husk)  
Vintage: 0-6 years

Bihar(बिहार)Map



## Araria, East Bihar

Technology: Biomass  
(crop)

Vintage: 2-10 years

~~Hardoi~~

Technology: SHS





# Sample Breakdown

## Household surveys

	No elec	Grid	Small-scale energy system			
			Biomass	Microhydro	Solar	
<b>Nepal</b>	14	81		90	53	<b>238</b>
<b>W. Bihar</b>	77	99	94		45	<b>315</b>
<b>E. Bihar</b>	134	95	77*		0	<b>306</b>
	<b>225</b>	<b>275</b>	<b>171</b>	<b>90</b>	<b>98</b>	<b>859</b>

\*includes 60 HH who had microgrid supply. Some don't anymore, switched to Grid.

## SME surveys

	Retail	Mechanical	Electrical	Hotel/ Restaurant	Others	
<b>Nepal</b>	12	10	3	7	10	<b>42</b>
<b>Bihar</b>	18	1	6	5	4	<b>34</b>



# Research Design

- Quantitative
  - Cross-sectional, controlled comparison of outcomes across 3 groups
    - Using Propensity Score Matching
    - Data: household surveys
- Qualitative
  - Livelihood impacts (location choices, income effects)
    - Data: Small-business interviews
- Literature review





# Supplier Context

- **Household supply** – dominates micro-hydro plant use but biomass plants need “anchor”
- **Supply hours** – households benefit in **evening**, commercial customers use grid or microgrid during the day
- **Financial barriers** – electricity connection cost plus costs of end-use equipment – **restrict commercial use** of off-grid systems





# Estimate of Daily Supply Hours

Mean (std dev)	Grid	Microgrid
Nepal	18 (2)	15 (5)
W. Bihar	6 (5)	4 (2)
E. Bihar	4 (4)	3 (2)

Microhydro availability >  
Biomass microgrid availability

In India, hours of grid supply inversely proportional to distance of village from paved road. Greater homogeneity in grid supply in Nepal

Grid: Higher availability  
vs. Lower Reliability

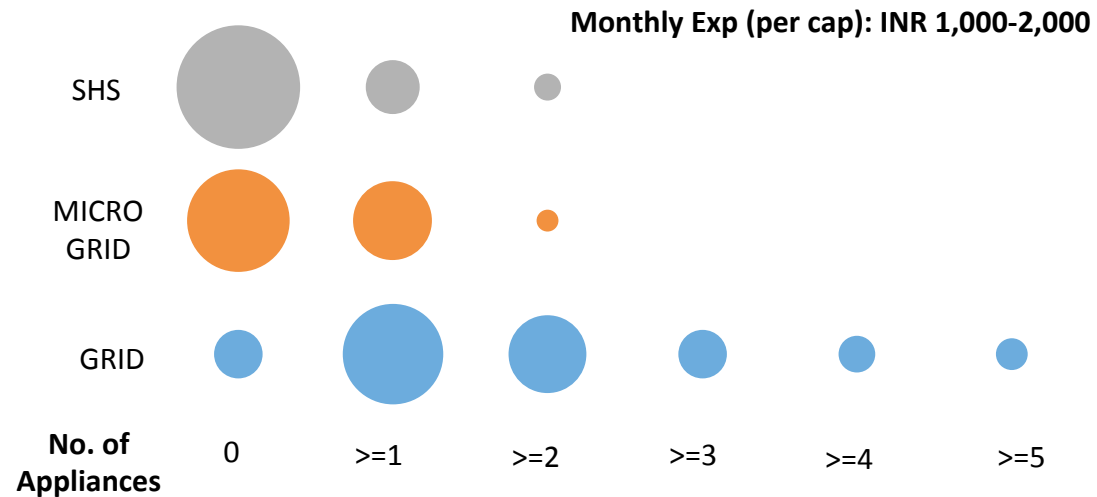
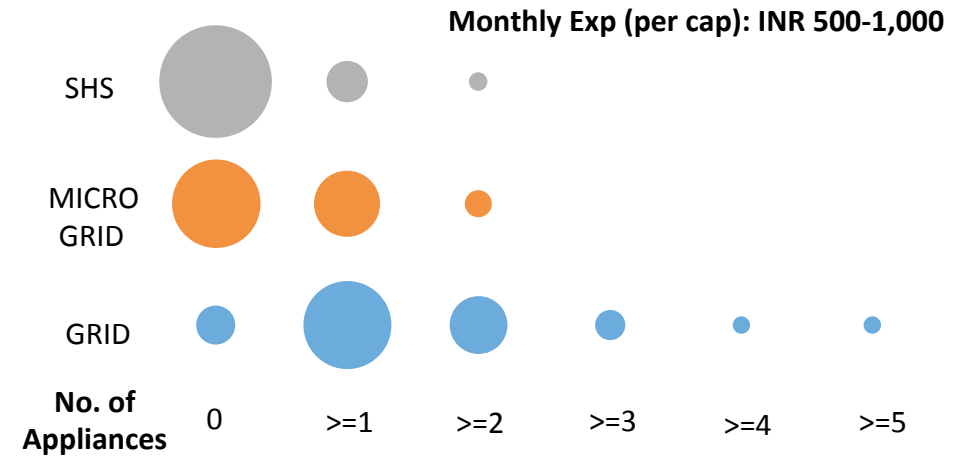
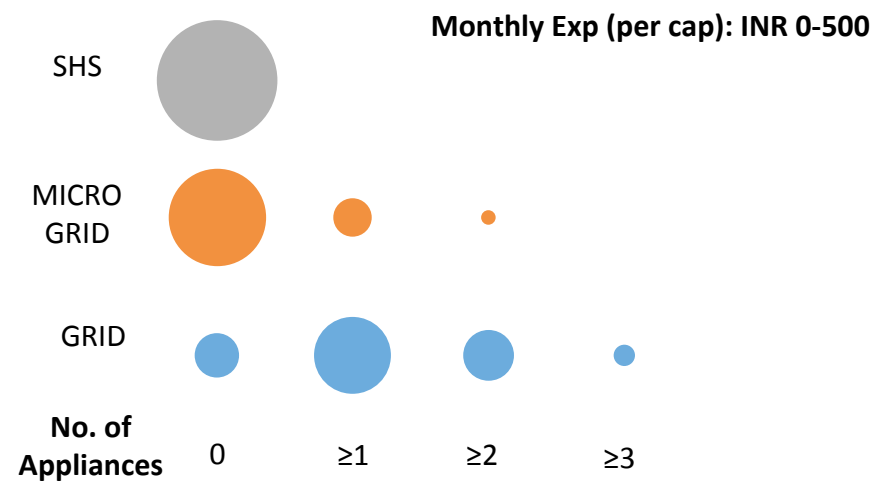


# Impacts on Household Income

- No discernable difference based on hours of supply and system type
- Small sample with high standard deviation



# Determinants of Appliance Ownership





# Cost of Electricity Supply

	Average Prices (Rs/kWh)				Electricity Expenditure Share				Monthly Costs			
Exp	India		Nepal		India		Nepal		India		Nepal	
Group	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid	Grid	Micro grid
<b>0-249</b>	20.8	44.0		8.4	7%	10%		3%	146	122		63
<b>250-499</b>	21.9	56.1	4.1	15.4	6%	4%	5%	4%	184	107	102	74
<b>500-999</b>	40.5	94.1	4.5	12.3	5%	2%	2%	3%	218	111	77	78
<b>1000-1999</b>	29.3	67.2	4.1	13.1	3%	2%	1%	2%	234	136	78	80
<b>2000+</b>	36.6	53.1	4.0	10.8	1%	1%	1%	1%	198	139	119	79

# Impact on Women's Time Use

- Electricity access → more time for income generating activities
- Shift in time use (from household chores to leisure) with grid connectivity
- Less time spent on keeping children engaged





# Small Scale Businesses

- Electricity is not a primary determinant of business choice/location
  - Nepal: road access dominates
  - Bihar: family, supplement to farm
- Electricity is essential, cost less of a factor
  - **Reliability paramount**: preference for more stable micro-grid
  - Poor supply constrains **(latent) demand**
- Electricity enhances SME customer base (e.g., TVs)





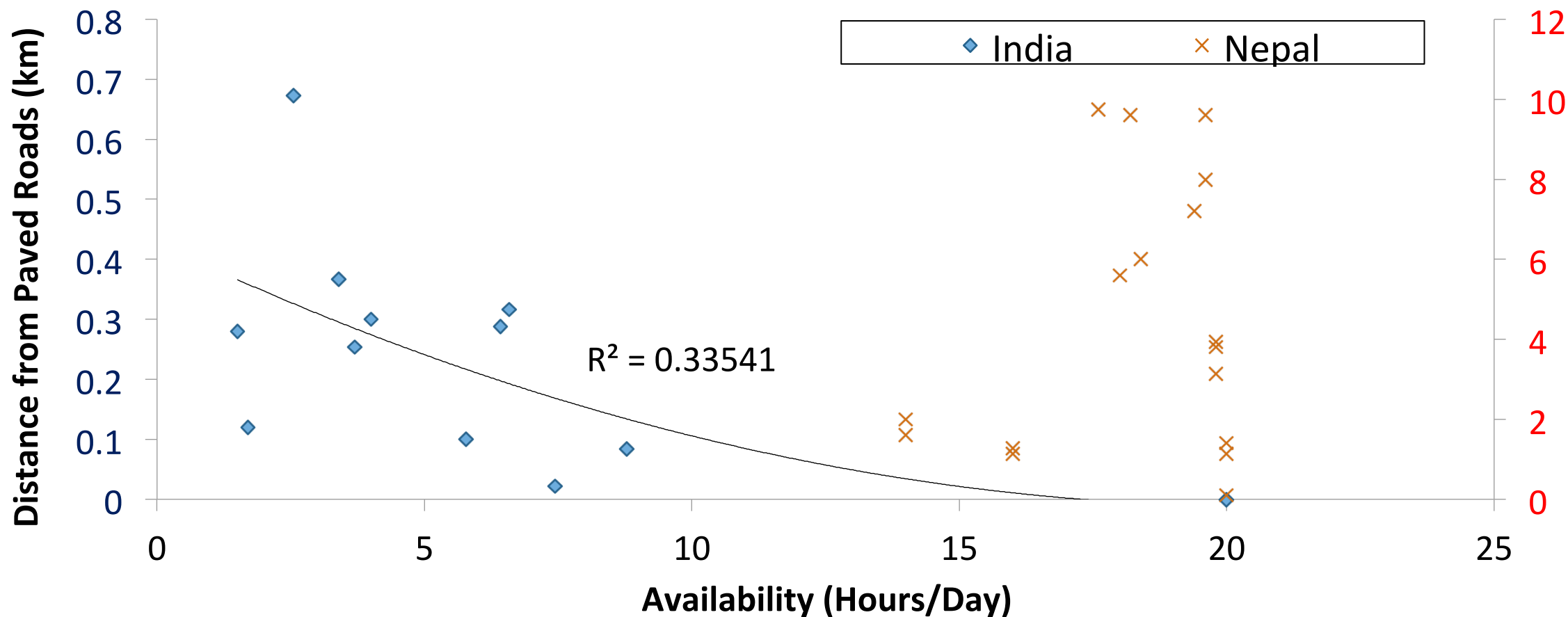


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**Thank you!**



# Village mean grid supply availability and distance from paved roads



# Impact on Children's Education

	Disagree	Agree	Agree (%)
Grid	42	196	82%
Microgrid	4	164	98%
Solar	2	67	97%
None	27	244	90%



# Determinants of Appliance Ownership

DV: Total appliances per cap	Coefficient	t-stat
Microgrid Dummy	-1.82***	(4.72)
SHS Dummy	-2.32***	(3.30)
Nepal Dummy	2.21***	(3.41)
Age of Elec Connection	0.25***	(7.05)
HH exp ('000 Rs/cap)	0.33**	(2.13)
Head of HH Education (1-4)	0.54***	(2.77)
Distance from paved road (km)	-0.07**	(1.99)
Hrs per day (30 day recall)	0.16***	(4.16)
R <sup>2</sup>	0.39	
N	498	

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

Reference Country is India, supply system is Grid

